



(19) **Europäisches Patentamt**
European Patent Office
Office européen des brevets



(11) **EP 0 892 050 A2**

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.01.1999 Bulletin 1999/03

(51) Int Cl.⁶: **C12N 15/12, C07K 14/47,**
C07K 16/18, C12Q 1/68,
A61K 38/17

(21) Application number: **98301168.5**

(22) Date of filing: **17.02.1998**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **08.07.1997 US 51937 P**
17.10.1997 US 953494

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(54) Human HFI2G53

(57) HFI2G53 polypeptides and polynucleotides and methods for producing such polypeptides by recombinant techniques are disclosed. Also disclosed are methods for utilizing HFI2G53 polypeptides and polynucleotides in the design of protocols for the treatment of bone loss including osteoporosis; inflammatory diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other im-

munodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including restenosis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; angina pectoris; ulcers; benign prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourette's syndrome, among others, and diagnostic assays for such conditions.

Description

This application claims the benefit of the U.S. Provisional Application No. 60/051,937, filed July 8, 1997.

5 **FIELD OF INVENTION**

This invention relates to newly identified polynucleotides, polypeptides encoded by them and to the use of such polynucleotides and polypeptides, and to their production. The polynucleotides and polypeptides of the present invention are hereinafter referred to as HFIZG53. The invention also relates to inhibiting or activating the action of such 10 polynucleotides and polypeptides.

BACKGROUND OF THE INVENTION

15 Evolutionary conservation of homologous gene products from distantly related organisms provides an information resource of great value for elucidating protein structure and function. Subregions of high sequence similarity found in proteins that have diverged over long periods of evolutionary time highlight domains within proteins that are of greatest structural and/or functional significance. A better understanding of a human protein's function can be gained by drawing upon the biological information known about related proteins from other species such as *S. cerevisiae*. The most 20 stringent definition of homology between two genes is statistically significant sequence similarity accompanied by functional complementation. There are a number of cases where expression of a human cDNA in vivo can complement a mutation in the homologous *S. cerevisiae* gene. In other cases, although the human gene is highly similar in sequence, it is unable to complement the yeast mutation. Nevertheless, these genes may be considered orthologs or functional 25 homologs if they are known to perform the same functions in their respective organisms. Clearly there is a need for identification and characterization of further members of this family which can play a role in preventing, ameliorating or correcting dysfunctions or diseases, including, but not limited to, bone loss including osteoporosis; inflammatory 30 diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other immunodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including restenosis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; angina pectoris; ulcers; benign prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourett's syndrome.

35 **SUMMARY OF THE INVENTION**

In one aspect, the invention relates to HFIZG53 polypeptides and recombinant materials and methods for their 40 production. Another aspect of the invention relates to methods for using such HFIZG53 polypeptides and polynucleotides. Such uses include the treatment of bone loss including osteoporosis; inflammatory diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly 45 infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other immunodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including restenosis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; 50 angina pectoris; ulcers; benign prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourett's syndrome, among others. In still another aspect, the invention relates to methods to identify agonists and antagonists using the materials provided by the invention, and treating conditions associated with HFIZG53 imbalance with the identified compounds. Yet another aspect of the invention relates to diagnostic assays for detecting diseases associated with inappropriate HFIZG53 activity or levels.

DESCRIPTION OF THE INVENTION**Definitions**

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The following definitions are provided to facilitate understanding of certain terms used frequently herein.

"HFIZG53" refers, among others, generally to a polypeptide having the amino acid sequence set forth in SEQ ID NO:2 or an allelic variant thereof.

"HFIZG53 activity or HFIZG53 polypeptide activity" or "biological activity of the HFIZG53 or HFIZG53 polypeptide" refers to the metabolic or physiologic function of said HFIZG53 including similar activities or improved activities or these activities with decreased undesirable side-effects. Also included are antigenic and immunogenic activities of said HFIZG53.

5 "HFIZG53 gene" refers to a polynucleotide having the nucleotide sequence set forth in SEQ ID NO:1 or allelic variants thereof and/or their complements.

"Antibodies" as used herein includes polyclonal and monoclonal antibodies, chimeric, single chain, and humanized antibodies, as well as Fab fragments, including the products of an Fab or other immunoglobulin expression library.

10 "Isolated" means altered "by the hand of man" from the natural state. If an "isolated" composition or substance occurs in nature, it has been changed or removed from its original environment, or both. For example, a polynucleotide or a polypeptide naturally present in a living animal is not "isolated," but the same polynucleotide or polypeptide separated from the coexisting materials of its natural state is "isolated", as the term is employed herein.

15 "Polynucleotide" generally refers to any polyribonucleotide or polydeoxribonucleotide, which may be unmodified RNA or DNA or modified RNA or DNA. "Polynucleotides" include, without limitation single- and double-stranded DNA, DNA that is a mixture of single- and double-stranded regions, single- and double-stranded RNA, and RNA that is a mixture of single-and double-stranded regions, hybrid molecules comprising DNA and RNA that may be single-stranded or, more typically, double-stranded or a mixture of single- and double-stranded regions. In addition, "polynucleotide" refers to triple-stranded regions comprising RNA or DNA or both RNA and DNA. The term polynucleotide also includes 20 DNAs or RNAs containing one or more modified bases and DNAs or RNAs with backbones modified for stability or for other reasons. "Modified" bases include, for example, tritylated bases and unusual bases such as inosine. A variety of modifications has been made to DNA and RNA; thus, "polynucleotide" embraces chemically, enzymatically or metabolically modified forms of polynucleotides as typically found in nature, as well as the chemical forms of DNA and RNA characteristic of viruses and cells. "Polynucleotide" also embraces relatively short polynucleotides, often referred to as oligonucleotides.

25 "Polypeptide" refers to any peptide or protein comprising two or more amino acids joined to each other by peptide bonds or modified peptide bonds, i.e., peptide isosteres. "Polypeptide" refers to both short chains, commonly referred to as peptides, oligopeptides or oligomers, and to longer chains, generally referred to as proteins. Polypeptides may contain amino acids other than the 20 gene-encoded amino acids. "Polypeptides" include amino acid sequences modified either by natural processes, such as posttranslational processing, or by chemical modification techniques which 30 are well known in the art. Such modifications are well described in basic texts and in more detailed monographs, as well as in a voluminous research literature. Modifications can occur anywhere in a polypeptide, including the peptide backbone, the amino acid side-chains and the amino or carboxyl termini. It will be appreciated that the same type of modification may be present in the same or varying degrees at several sites in a given polypeptide. Also, a given polypeptide may contain many types of modifications. Polypeptides may be branched as a result of ubiquitination, and 35 they may be cyclic, with or without branching. Cyclic, branched and branched cyclic polypeptides may result from posttranslation natural processes or may be made by synthetic methods. Modifications include acetylation, acylation, ADP-ribosylation, amidation, covalent attachment of flavin, covalent attachment of a heme moiety, covalent attachment of a nucleotide or nucleotide derivative, covalent attachment of a lipid or lipid derivative, covalent attachment of phosphotidylinositol, cross-linking, cyclization, disulfide bond formation, demethylation, formation of covalent crosslinks, 40 formation of cystine, formation of pyroglutamate, formylation, gamma-carboxylation, glycosylation, GPI anchor formation, hydroxylation, iodination, methylation, myristylation, oxidation, proteolytic processing, phosphorylation, prenylation, racemization, selenylation, sulfation, transfer-RNA mediated addition of amino acids to proteins such as arginylation, and ubiquitination. See, for instance, PROTEINS - STRUCTURE AND MOLECULAR PROPERTIES, 2nd Ed., T. E. Creighton, W. H. Freeman and Company, New York, 1993 and Wold, F., Posttranslational Protein Modifications: Perspectives and Prospects, pgs. 1-12 in POSTTRANSLATIONAL COVALENT MODIFICATION OF PROTEINS, 45 B. C. Johnson, Ed., Academic Press, New York, 1983; Seifter *et al.*, "Analysis for protein modifications and nonprotein cofactors", *Meth Enzymol* (1990) 182:626-646 and Rattan *et al.*, "Protein Synthesis: Posttranslational Modifications and Aging", *Ann NY Acad Sci* (1992) 663:48-62.

50 "Variant" as the term is used herein, is a polynucleotide or polypeptide that differs from a reference polynucleotide or polypeptide respectively, but retains essential properties. A typical variant of a polynucleotide differs in nucleotide sequence from another, reference polynucleotide. Changes in the nucleotide sequence of the variant may or may not alter the amino acid sequence of a polypeptide encoded by the reference polynucleotide. Nucleotide changes may result in amino acid substitutions, additions, deletions, fusions and truncations in the polypeptide encoded by the reference sequence, as discussed below. A typical variant of a polypeptide differs in amino acid sequence from another, 55 reference polypeptide. Generally, differences are limited so that the sequences of the reference polypeptide and the variant are closely similar overall and, in many regions, identical. A variant and reference polypeptide may differ in amino acid sequence by one or more substitutions, additions, deletions in any combination. A substituted or inserted amino acid residue may or may not be one encoded by the genetic code. A variant of a polynucleotide or polypeptide

may be a naturally occurring such as an allelic variant, or it may be a variant that is not known to occur naturally. Non-naturally occurring variants of polynucleotides and polypeptides may be made by mutagenesis techniques or by direct synthesis.

"Identity" is a measure of the identity of nucleotide sequences or amino acid sequences. In general, the sequences are aligned so that the highest order match is obtained. "Identity" *per se* has an art-recognized meaning and can be calculated using published techniques. See, e.g.: (COMPUTATIONAL MOLECULAR BIOLOGY, Lesk, A.M., ed., Oxford University Press, New York, 1988; BIOCOMPUTING: INFORMATICS AND GENOME PROJECTS, Smith, D.W., ed., Academic Press, New York, 1993; COMPUTER ANALYSIS OF SEQUENCE DATA, PART I, Griffin, A.M., and Griffin, H.G., eds., Humana Press, New Jersey, 1994; SEQUENCE ANALYSIS IN MOLECULAR BIOLOGY, von Heijne, G., Academic Press, 1987; and SEQUENCE ANALYSIS PRIMER, Gribskov, M. and Devereux, J., eds., M Stockton Press, New York, 1991). While there exist a number of methods to measure identity between two polynucleotide or polypeptide sequences, the term "identity" is well known to skilled artisans (Carillo, H., and Lipton, D., *SIAM J Applied Math* (1988) 48:1073). Methods commonly employed to determine identity or similarity between two sequences include, but are not limited to, those disclosed in Guide to Huge Computers, Martin J. Bishop, ed., Academic Press, San Diego, 1994, and Carillo, H., and Lipton, D., *SIAM J Applied Math* (1988) 48:1073. Methods to determine identity and similarity are codified in computer programs. Preferred computer program methods to determine identity and similarity between two sequences include, but are not limited to, GCS program package (Devereux, J., *et al.*, *Nucleic Acids Research* (1984) 12(1):387), BLASTP, BLASTN, FASTA (Atschul, S.F. *et al.*, *J Molec Biol* (1990) 215:403).

As an illustration, by a polynucleotide having a nucleotide sequence having at least, for example, 95% "identity" to a reference nucleotide sequence of SEQ ID NO: 1 is intended that the nucleotide sequence of the polynucleotide is identical to the reference sequence except that the polynucleotide sequence may include up to five point mutations per each 100 nucleotides of the reference nucleotide sequence of SEQ ID NO: 1. In other words, to obtain a polynucleotide having a nucleotide sequence at least 95% identical to a reference nucleotide sequence, up to 5% of the nucleotides in the reference sequence may be deleted or substituted with another nucleotide, or a number of nucleotides up to 5% of the total nucleotides in the reference sequence may be inserted into the reference sequence. These mutations of the reference sequence may occur at the 5 or 3 terminal positions of the reference nucleotide sequence or anywhere between those terminal positions, interspersed either individually among nucleotides in the reference sequence or in one or more contiguous groups within the reference sequence.

Similarly, by a polypeptide having an amino acid sequence having at least, for example, 95% "identity" to a reference amino acid sequence of SEQ ID NO:2 is intended that the amino acid sequence of the polypeptide is identical to the reference sequence except that the polypeptide sequence may include up to five amino acid alterations per each 100 amino acids of the reference amino acid of SEQ ID NO: 2. In other words, to obtain a polypeptide having an amino acid sequence at least 95% identical to a reference amino acid sequence, up to 5% of the amino acid residues in the reference sequence may be deleted or substituted with another amino acid, or a number of amino acids up to 5% of the total amino acid residues in the reference sequence may be inserted into the reference sequence. These alterations of the reference sequence may occur at the amino or carboxy terminal positions of the reference amino acid sequence or anywhere between those terminal positions, interspersed either individually among residues in the reference sequence or in one or more contiguous groups within the reference sequence.

40 Polypeptides of the Invention

In one aspect, the present invention relates to HFIZG53 polypeptides (or HFIZGS3 proteins). The HFIZG53 polypeptides include the polypeptide of SEQ ID NOS:2 and 4; as well as polypeptides comprising the amino acid sequence of SEQ ID NO: 2; and polypeptides comprising the amino acid sequence which have at least 80% identity to that of SEQ ID NO:2 over its entire length, and still more preferably at least 90% identity, and even still more preferably at least 95% identity to SEQ ID NO: 2. Furthermore, those with at least 97-99% are highly preferred. Also included within HFIZG53 polypeptides are polypeptides having the amino acid sequence which have at least 80% identity to the polypeptide having the amino acid sequence of SEQ ID NO:2 over its entire length, and still more preferably at least 90% identity, and still more preferably at least 95% identity to SEQ ID NO:2. Furthermore, those with at least 97-99% are highly preferred. Preferably HFIZG53 polypeptide exhibit at least one biological activity of HFIZG53.

The HFIZG53 polypeptides may be in the form of the "mature" protein or may be a part of a larger protein such as a fusion protein. It is often advantageous to include an additional amino acid sequence which contains secretory or leader sequences, pro-sequences, sequences which aid in purification such as multiple histidine residues, or an additional sequence for stability during recombinant production.

55 Fragments of the HFIZG53 polypeptides are also included in the invention. A fragment is a polypeptide having an amino acid sequence that entirely is the same as part, but not all, of the amino acid sequence of the aforementioned HFIZG53 polypeptides. As with HFIZG53 polypeptides, fragments may be "free-standing," or comprised within a larger polypeptide of which they form a part or region, most preferably as a single continuous region. Representative examples

of polypeptide fragments of the invention, include, for example, fragments from about amino acid number 1-20, 21-40, 41-60, 61-80, 81-100, and 101 to the end of HFIZG53 polypeptide. In this context "about" includes the particularly recited ranges larger or smaller by several, 5, 4, 3, 2 or 1 amino acid at either extreme or at both extremes.

Preferred fragments include, for example, truncation polypeptides having the amino acid sequence of HFIZG53 polypeptides, except for deletion of a continuous series of residues that includes the amino terminus, or a continuous series of residues that includes the carboxyl terminus or deletion of two continuous series of residues, one including the amino terminus and one including the carboxyl terminus. Also preferred are fragments characterized by structural or functional attributes such as fragments that comprise alpha-helix and alpha-helix forming regions, beta-sheet and beta-sheet-forming regions, turn and turn-forming regions, coil and coil-forming regions, hydrophilic regions, hydrophobic regions, alpha amphipathic regions, beta amphipathic regions, flexible regions, surface-forming regions, substrate binding region, and high antigenic index regions. Other preferred fragments are biologically active fragments. Biologically active fragments are those that mediate HFIZG53 activity, including those with a similar activity or an improved activity, or with a decreased undesirable activity. Also included are those that are antigenic or immunogenic in an animal, especially in a human.

Preferably, all of these polypeptide fragments retain the biological activity of the HFIZG53, including antigenic activity. Among the most preferred fragment is that having the amino acid sequence of SEQ ID NO: 4. Variants of the defined sequence and fragments also form part of the present invention. Preferred variants are those that vary from the referents by conservative amino acid substitutions -- i.e., those that substitute a residue with another of like characteristics. Typical such substitutions are among Ala, Val, Leu and Ile; among Ser and Thr; among the acidic residues Asp and Glu; among Asn and Gln; and among the basic residues Lys and Arg; or aromatic residues Phe and Tyr. Particularly preferred are variants in which several, 5-10, 1-5, or 1-2 amino acids are substituted, deleted, or added in any combination.

The HFIZG53 polypeptides of the invention can be prepared in any suitable manner. Such polypeptides include isolated naturally occurring polypeptides, recombinantly produced polypeptides, synthetically produced polypeptides, or polypeptides produced by a combination of these methods. Means for preparing such polypeptides are well understood in the art.

Polynucleotides of the Invention

Another aspect of the invention relates to HFIZG53 polynucleotides. HFIZG53 polynucleotides include isolated polynucleotides which encode the HFIZG53 polypeptides and fragments, and polynucleotides closely related thereto. More specifically, HFIZG53 polynucleotide of the invention include a polynucleotide comprising the nucleotide sequence contained in SEQ ID NO: 1 encoding a HFIZG53 polypeptide of SEQ ID NO: 2, and polynucleotides having the particular sequences of SEQ ID NOS: 1 and 3. HFIZG53 polynucleotides further include a polynucleotide comprising a nucleotide sequence that has at least 80% identity over its entire length to a nucleotide sequence encoding the HFIZG53 polypeptide of SEQ ID NO: 2, and a polynucleotide comprising a nucleotide sequence that is at least 80% identical to that of SEQ ID NO: 1 over its entire length. In this regard, polynucleotides at least 90% identical are particularly preferred, and those with at least 95% are especially preferred. Furthermore, those with at least 97% are highly preferred and those with at least 98-99% are most highly preferred, with at least 99% being the most preferred. Also included under HFIZG53 polynucleotides are a nucleotide sequence which has sufficient identity to a nucleotide sequence contained in SEQ ID NO: 1 to hybridize under conditions useable for amplification or for use as a probe or marker. The invention also provides polynucleotides which are complementary to such HFIZG53 polynucleotides.

The cDNA sequence of SEQ ID NO: 1 contains an open reading frame (nucleotide number 154 to 879) encoding a polypeptide of 242 amino acids of SEQ ID NO: 2. The amino acid sequence of Table 1 (SEQ ID NO: 2) has about 54% identity (using BLAST) in 81 of 150 amino acid residues with ZC373.5 of *C. elegans* (Z49131). The nucleotide sequence of Table 1 (SEQ ID NO: 1) has about 66 % identity (using BLAST) in 48 of 127 nucleotide residues with *Caenorhabditis elegans* cosmid R10E4 (gb|Z50874|CER10E4). Thus, HFIZG53 polypeptides and polynucleotides of the present invention are expected to have, inter alia, similar biological functions/properties to their homologous polypeptides and polynucleotides, and their utility is obvious to anyone skilled in the art.

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Table 1^a

5 1 TGCAAATATT TTGCTGTTAA GGATTTAAAA ATAAACAGAA ACATAGAGTA
51 TAAAATTTTC ATTTCACTGT GCCCTCATT AAAATTATAA GAATATAAGC
10 101 AAATAACATC CAATGT CAGA AGAGATT CAG GGTGACCATT TGCACTATT

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5	151	AGTGGCAAAT TAGTAGCATC ATGAAAAATT TCAATT CATT TAAAAAAATA
10	201	GCTTT CATT AAATAATAAT TACGTTAGC TTTATCTCTG TATATAATT A
15	251	GACTTT CTTT TGGCTTAGAC AATTCCATT TCTCCAAGTG GGAGCTGTGA
20	301	AGGATCaaGT CCTACTTTCT T CATTGATAC GGCaATATCa aATAAATAGT
25	351	CaTAACACTC ACaCaTGGTT TTGGCCTTCT CCCATGTTTC CCCCCACACA
30	401	TATACTCCAT GACGTCTGAC CAGTACTGCA CAGGAGTCTG GCTATT CATT
35	451	CATTGCATGA GCCATTCTAT CTTTGAGGT C TTTCTCCTCA GGTGTATT CT
40	501	CAATAATGGG TACCACTAAC ATATCATCAT ATCTATAATA CCCTCCGGAA
45	551	GTACATTCTT TTATT CCTTT TATCATCTCT TGATGTGTAA TTTTAAACTC
50	601	CCGT CCTGGA AAGAGAAGGG TGGCCATCAC AGCAGCTTTA GAGTGGGTAT
55	651	GAATCACTGC ACCTGCTCCT CT CATTGTGT AAGCATCAT GAAAAGAGGA
60	701	GTACACTGGC TTTTTTTAG CTTCTT CGAT GGCGAAGGT C CACTTATGT C
65	751	CTTTT CATT ATATCATAAA CAAACATGT C TT CAGGCTGA ATT CGTT CCT
70	801	TTTGCCTCC TGAAGGAGCA ATGTAGATT CATCGCCATG CTTCAAGCTA
75	851	ATT CCTCCTC CAGTCCCAGT GACCCAGCCT AAATGGTAAA ACTGTTTGCA
80	901	AAGTTCTGGG ATCAGGTATC TTGGATGCTC CTTGT CCTGC GCGCCGATC
85	951	TCCGGGAACA ACAGTCTCCC TCCCAGCAT CACAGCCAGA CATGGCCCAG
90	1001	ACCAGGGACC CGCGCGGCCT CCAATCTCCG CACGGCTTG CGCGCAGCGC
95	1051	TTAGCCTGGG ATGCGGCAGC GAGGCCGCAA ATGCAATCAG GCAGCGCTGA
100	1101	GGGCAGCCCG GGGGCGGGGC GAACGGGGCG CGGACCGT G GGT CGACCCG
105	1151	GGAATTCCGG ACCGGTACCT GCAGGCGTAC CAGCTTTCCC

^a A nucleotide sequence of a human HFIZG53 (SEQ ID NO: 1).

Table 2^b

5	1	MSGCDAWEGD CCSRRCGAQD KEHP RYLIPE LCKQFYHLGW VTGTGGGI SL
10	51	KHGDEIYIAP SGVQKE RIQP EDMFVYDINE KDI SGP SP SK KLKK SQ CTP
15	101	FMNAYTMRGA GAVIHTH SKA AVMATLLFPG REFKITHQEM IKGIKKCT SG
20	151	GYY RYDDMLV VPPIENTPEE KDLKD RMAHA MNEYPD SCAV LV RRHGVYVW
	201	GETWEKAKTM CECYDYLFDI AVSMKKVGLD PSQLPGENG IV*

^b An amino acid sequence of a human HFIZG53 (SEQ ID NO: 2).

One polynucleotide of the present invention encoding HFIZG53 may be obtained using standard cloning and screening, from a cDNA library derived from mRNA in cells of human Jurkat T-cell G1 phase; Bone Marrow Cell Line (RS4;11); Soares multiple sclerosis 2NbHMSP; NTERA2 + retinoic acid, 14 days; Hodgkin's Lymphoma II; Human Adipose Tissue; Stratagene endothelial cell 937223; Synovial Fibroblasts (IL1/TNF) subto; Soares NbHTGBC using the expressed sequence tag (EST) analysis (Adams, M.D., *et al. Science* (1991) 252:1651-1656; Adams, M.D. *et al., Nature*, (1992) 355:632-634; Adams, M.D., *et al., Nature* (1995) 377 Supp:3-174). Polynucleotides of the invention can also be obtained from natural sources such as genomic DNA libraries or can be synthesized using well known and commercially available techniques.

The nucleotide sequence encoding HFIZG53 polypeptide of SEQ ID NO:2 may be identical to the polypeptide encoding sequence contained in Table 1 (nucleotide number 154 to 879 of SEQ ID NO:1), or it may be a sequence, which as a result of the redundancy (degeneracy) of the genetic code, also encodes the polypeptide of SEQ ID NO:2.

When the polynucleotides of the invention are used for the recombinant production of HFIZG53 polypeptide, the polynucleotide may include the coding sequence for the mature polypeptide or a fragment thereof, by itself; the coding sequence for the mature polypeptide or fragment in reading frame with other coding sequences, such as those encoding a leader or secretory sequence, a pre-, or pro- or prepro- protein sequence, or other fusion peptide portions. For example, a marker sequence which facilitates purification of the fused polypeptide can be encoded. In certain preferred embodiments of this aspect of the invention, the marker sequence is a hexa-histidine peptide, as provided in the pQE vector (Qiagen, Inc.) and described in Gentz *et al., Proc Natl Acad Sci USA* (1989) 86:821-824, or is an HA tag. The polynucleotide may also contain noncoding 5' and 3' sequences, such as transcribed, non-translated sequences, splicing and polyadenylation signals, ribosome binding sites and sequences that stabilize mRNA.

Further preferred embodiments are polynucleotides encoding HFIZG53 variants comprising the amino acid sequence of HFIZG53 polypeptide of Table 2 (SEQ ID NO:2) in which several, 5-10, 1-5, 1-3, 1-2 or 1 amino acid residues are substituted, deleted or added, in any combination. Among the preferred polynucleotides of the present invention is contained in Table 3 (SEQ ID NO: 3) encoding the amino acid sequence of Table 4 (SEQ ID NO: 4).

Table 3^c

5	1	CCCCCGTT CG CCCCGCCCCC GGGCTGCCCT CAGCGCTGCC TGATTGCATT
	51	TGCGGACCCCT CGCGTGCCGA CCCAGGCTAA GCGCCGCGCA AAAGCCGTGC
10	101	GGAGAGTTGGA GGCGCGCGG GTCCCTGGTC TGGGCCATGT CTGGCTGTGA
	151	TGCTCGGGAG GGAGACTGTT GTTCCCGGAG ATGCGGCGCG CAGGACAAGG
15	201	AGCATCCAAG ATACCTGATC CCAGAACATT GCACACAGTT TTACCATTTA
	251	GGCTGGGTCA CTGGGACTGG AGGAGGAATT AGCTTGAAGC ATGGCGATGA
20	301	AATCTACATT GCTCCTTCAG GATGCAAAAG GAACGAATT C AGCCTGAAGA
	351	CATGTTGTT TGTGATATAA ATGAAAAGGA CATAAGTGGG ACCTTCGCCA
25	401	T CGAAGAAC TAAAAAAAAG CCAGTGTACT CCTCTTTCA TGAATGCTTA
	451	CACAATGAGA GGAGCAGGTG CAGTGATTCA TACCCACTCT AAAGCTGCTG
30	501	TGATGGCCAC ACTTCTCTT CCAGGACGGG AGTTTAAAAT TACACATCAA
	551	GAGATGATAA AAGGAATAAA GAAATGTACT TCCGGAGGT A TTATAGATAT
35	601	GATGATATGT TAGTGGTACC CATTATTGAG AATACACCCG GAGGAGAAAG

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651	ACCCCAAAGA TAGAATGGCC CGGCCNACCA ATTGATACCC AGACTCCTGT
701	GCATACTGGT CAACGGCTGG GNGTATATTN TTTGGGGGGG AACATGGGAG
751	AAGGCCAAC CNGTGTGATT TTATGNCATT ATTTGAAATT GCCGTTCCAT
801	NAGAATNGGG CTTNCCCTTC AAATCCCCTT TGGG

^c A partial nucleotide sequence of a human HFIZG53 (SEQ ID NO: 3).

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Table 4^d

5 KKLKK SQCTPLFMNAYTMRGAGAVIHTH SKAAVMATLLF

^d A partial amino acid sequence of a human HFI2G53 (SEQ ID NO: 4).

10 The present invention further relates to polynucleotides that hybridize to the herein above-described sequences. In this regard, the present invention especially relates to polynucleotides which hybridize under stringent conditions to the herein above-described polynucleotides. As herein used, the term "stringent conditions" means hybridization will occur only if there is at least 80%, and preferably at least 90%, and more preferably at least 95%, yet even more preferably 97-99% identity between the sequences.

15 Polynucleotides of the invention, which are identical or sufficiently identical to a nucleotide sequence contained in SEQ ID NO: 1 or a fragment thereof (including that of SEQ ID NO:3), may be used as hybridization probes for cDNA and genomic DNA, to isolate full-length cDNAs and genomic clones encoding HFI2G53 polypeptide and to isolate cDNA and genomic clones of other genes (including genes encoding homologs and orthologs from species other than human) that have a high sequence similarity to the HFI2G53 gene. Such hybridization techniques are known to those of skill in the art. Typically these nucleotide sequences are 80% identical, preferably 90% identical, more preferably 20 95% identical to that of the referent. The probes generally will comprise at least 15 nucleotides. Preferably, such probes will have at least 30 nucleotides and may have at least 50 nucleotides. Particularly preferred probes will range between 30 and 50 nucleotides.

25 In one embodiment, to obtain a polynucleotide encoding HFI2G53 polypeptide, including homologs and orthologs from species other than human, comprises the steps of screening an appropriate library under stringent hybridization conditions with a labeled probe having the SEQ ID NO: 1 or a fragment thereof (including that of SEQ ID NO: 3), and isolating full-length cDNA and genomic clones containing said polynucleotide sequence. Such hybridization techniques are well known to those of skill in the art. Thus in another aspect, HFI2G53 polynucleotides of the present invention further include a nucleotide sequence comprising a nucleotide sequence that hybridize under stringent condition to a nucleotide sequence having SEQ ID NO: 1 or a fragment thereof (including that of SEQ ID NO:3). Also included with 30 HFI2G53 polypeptides are polypeptide comprising amino acid sequence encoded by nucleotide sequence obtained by the above hybridization condition. Stringent hybridization conditions are as defined above or, alternatively, conditions under overnight incubation at 42°C in a solution comprising: 50% formamide, SxSSC (150mM NaCl, 15mM trisodium citrate), 50 mM sodium phosphate (pH7.6), 5x Denhardt's solution, 10 % dextran sulfate, and 20 microgram/ml denatured, sheared salmon sperm DNA, followed by washing the filters in 0.1 x SSC at about 65°C.

35 The polynucleotides and polypeptides of the present invention may be employed as research reagents and materials for discovery of treatments and diagnostics to animal and human disease.

Vectors, Host Cells, Expression

40 The present invention also relates to vectors which comprise a polynucleotide or polynucleotides of the present invention, and host cells which are genetically engineered with vectors of the invention and to the production of polypeptides of the invention by recombinant techniques. Cell-free translation systems can also be employed to produce such proteins using RNAs derived from the DNA constructs of the present invention.

45 For recombinant production, host cells can be genetically engineered to incorporate expression systems or portions thereof for polynucleotides of the present invention. Introduction of polynucleotides into host cells can be effected by methods described in many standard laboratory manuals, such as Davis et al., *BASIC METHODS IN MOLECULAR BIOLOGY* (1986) and Sambrook et al., *MOLECULAR CLONING: A LABORATORY MANUAL*, 2nd Ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. (1989) such as calcium phosphate transfection, DEAE-dextran mediated transfection, transvection, microinjection, cationic lipid-mediated transfection, electroporation, transduction, 50 scrape loading, ballistic introduction or infection.

55 Representative examples of appropriate hosts include bacterial cells, such as streptococci, staphylococci, *E. coli*, *Streptomyces* and *Bacillus subtilis* cells; fungal cells, such as yeast cells and *Aspergillus* cells; insect cells such as *Drosophila* S2 and *Spodoptera* Sf9 cells; animal cells such as CHO, COS, HeLa, C127, 3T3, BHK, HEK 293 and Bowes melanoma cells; and plant cells.

55 A great variety of expression systems can be used. Such systems include, among others, chromosomal, episomal and virus-derived systems, e.g., vectors derived from bacterial plasmids, from bacteriophage, from transposons, from yeast episomes, from insertion elements, from yeast chromosomal elements, from viruses such as baculoviruses, papova viruses, such as SV40, vaccinia viruses, adenoviruses, fowl pox viruses, pseudorabies viruses and retrovirus-

es. and vectors derived from combinations thereof, such as those derived from plasmid and bacteriophage genetic elements, such as cosmids and phagemids. The expression systems may contain control regions that regulate as well as engender expression. Generally, any system or vector suitable to maintain, propagate or express polynucleotides to produce a polypeptide in a host may be used. The appropriate nucleotide sequence may be inserted into an expression system by any of a variety of well-known and routine techniques, such as, for example, those set forth in Sambrook *et al.*, *MOLECULAR CLONING, A LABORATORY MANUAL (supra)*.

For secretion of the translated protein into the lumen of the endoplasmic reticulum, into the periplasmic space or into the extracellular environment, appropriate secretion signals may be incorporated into the desired polypeptide. These signals may be endogenous to the polypeptide or they may be heterologous signals.

If the HFIZG53 polypeptide is to be expressed for use in screening assays, generally, it is preferred that the polypeptide be produced at the surface of the cell. In this event, the cells may be harvested prior to use in the screening assay. If HFIZG53 polypeptide is secreted into the medium, the medium can be recovered in order to recover and purify the polypeptide; if produced intracellularly, the cells must first be lysed before the polypeptide is recovered. HFIZG53 polypeptides can be recovered and purified from recombinant cell cultures by well-known methods including ammonium sulfate or ethanol precipitation, acid extraction, anion or cation exchange chromatography, phosphocellulose chromatography, hydrophobic interaction chromatography, affinity chromatography, hydroxylapatite chromatography and lectin chromatography. Most preferably, high performance liquid chromatography is employed for purification. Well known techniques for refolding proteins may be employed to regenerate active conformation when the polypeptide is denatured during isolation and or purification.

Diagnostic Assays

This invention also relates to the use of HFIZG53 polynucleotides for use as diagnostic reagents. Detection of a mutated form of HFIZG53 gene associated with a dysfunction will provide a diagnostic tool that can add to or define a diagnosis of a disease or susceptibility to a disease which results from under-expression, over-expression or altered expression of HFIZG53. Individuals carrying mutations in the HFIZG53 gene may be detected at the DNA level by a variety of techniques.

Nucleic acids for diagnosis may be obtained from a subject's cells, such as from blood, urine, saliva, tissue biopsy or autopsy material. The genomic DNA may be used directly for detection or may be amplified enzymatically by using PCR or other amplification techniques prior to analysis. RNA or cDNA may also be used in similar fashion. Deletions and insertions can be detected by a change in size of the amplified product in comparison to the normal genotype. Point mutations can be identified by hybridizing amplified DNA to labeled HFIZG53 nucleotide sequences. Perfectly matched sequences can be distinguished from mismatched duplexes by RNase digestion or by differences in melting temperatures. DNA sequence differences may also be detected by alterations in electrophoretic mobility of DNA fragments in gels, with or without denaturing agents, or by direct DNA sequencing. See, e.g., Myers *et al.*, *Science* (1985) 230:1242. Sequence changes at specific locations may also be revealed by nuclease protection assays, such as RNase and S1 protection or the chemical cleavage method. See Cotton *et al.*, *Proc Natl Acad Sci USA* (1985) 85: 4397-4401. In another embodiment, an array of oligonucleotides probes comprising HFIZG53 nucleotide sequence or fragments thereof can be constructed to conduct efficient screening of e.g., genetic mutations. Array technology methods are well known and have general applicability and can be used to address a variety of questions in molecular genetics including gene expression, genetic linkage, and genetic variability. (See for example: M.Chee *et al.*, *Science*, Vol 274, pp 610-613 (1996)).

The diagnostic assays offer a process for diagnosing or determining a susceptibility to bone loss including osteoporosis; inflammatory diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other immunodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including restenosis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; angina pectoris; ulcers; benign prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourett's syndrome through detection of mutation in the HFIZG53 gene by the methods described.

In addition, bone loss including osteoporosis; inflammatory diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other immunodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including restenosis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; angina pectoris; ulcers; benign

prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourett's syndrome, can be diagnosed by methods comprising determining from a sample derived from a subject an abnormally decreased or increased level of HFIZG53 polypeptide or HFIZG53 mRNA. Decreased or increased expression can be measured at the RNA level using any of the methods well known in the art for the quantitation of polynucleotides, such as, for example, PCR, RT-PCR, RNase protection, Northern blotting and other hybridization methods. Assay techniques that can be used to determine levels of a protein, such as an HFIZG53 polypeptide, in a sample derived from a host are well-known to those of skill in the art. Such assay methods include radioimmunoassays, competitive-binding assays, Western Blot analysis and ELISA assays.

Thus in another aspect, the present invention relates to a diagnostic kit for a disease or susceptibility to a disease, particularly bone loss including osteoporosis; inflammatory diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other immunodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including restenosis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; angina pectoris; ulcers; benign prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourett's syndrome, which comprises:

- (a) a HFIZG53 polynucleotide, preferably the nucleotide sequence of SEQ ID NO: 1, or a fragment thereof;
- (b) a nucleotide sequence complementary to that of (a);
- (c) a HFIZG53 polypeptide, preferably the polypeptide of SEQ ID NO: 2, or a fragment thereof; or
- (d) an antibody to a HFIZG53 polypeptide, preferably to the polypeptide of SEQ ID NO: 2.

It will be appreciated that in any such kit, (a), (b), (c) or (d) may comprise a substantial component.

Chromosome Assays

The nucleotide sequences of the present invention are also valuable for chromosome identification. The sequence is specifically targeted to and can hybridize with a particular location on an individual human chromosome. The mapping of relevant sequences to chromosomes according to the present invention is an important first step in correlating those sequences with gene associated disease. Once a sequence has been mapped to a precise chromosomal location, the physical position of the sequence on the chromosome can be correlated with genetic map data. Such data are found, for example, in V. McKusick, *Mendelian Inheritance in Man* (available on line through Johns Hopkins University Welch Medical Library). The relationship between genes and diseases that have been mapped to the same chromosomal region are then identified through linkage analysis (coinheritance of physically adjacent genes). The differences in the cDNA or genomic sequence between affected and unaffected individuals can also be determined. If a mutation is observed in some or all of the affected individuals but not in any normal individuals, then the mutation is likely to be the causative agent of the disease.

Antibodies

The polypeptides of the invention or their fragments or analogs thereof, or cells expressing them can also be used as immunogens to produce antibodies immunospecific for the HFIZG53 polypeptides. The term "immunospecific" means that the antibodies have substantially greater affinity for the polypeptides of the invention than their affinity for other related polypeptides in the prior art.

Antibodies generated against the HFIZG53 polypeptides can be obtained by administering the polypeptides or epitope-bearing fragments, analogs or cells to an animal, preferably a nonhuman, using routine protocols. For preparation of monoclonal antibodies, any technique which provides antibodies produced by continuous cell line cultures can be used. Examples include the hybridoma technique (Kohler, G. and Milstein, C., *Nature* (1975) 256:495-497), the trioma technique, the human B-cell hybridoma technique (Kozbor *et al.*, *Immunology Today* (1983) 4:72) and the EBV-hybridoma technique (Cole *et al.*, *MONOCLONAL ANTIBODIES AND CANCER THERAPY*, pp. 77-96, Alan R. Liss, Inc., 1985).

Techniques for the production of single chain antibodies (U.S. Patent No. 4,946,778) can also be adapted to produce single chain antibodies to polypeptides of this invention. Also, transgenic mice, or other organisms including other mammals, may be used to express humanized antibodies.

The above-described antibodies may be employed to isolate or to identify clones expressing the polypeptide or to

purify the polypeptides by affinity chromatography.

Antibodies against HFIZG53 polypeptides may also be employed to treat bone loss including osteoporosis; inflammatory diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other immunodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including restenosis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; angina pectoris; ulcers; benign prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourette's syndrome, among others.

Vaccines

Another aspect of the invention relates to a method for inducing an immunological response in a mammal which comprises inoculating the mammal with HFIZG53 polypeptide, or a fragment thereof, adequate to produce antibody and/or T cell immune response to protect said animal from bone loss including osteoporosis; inflammatory diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other immunodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including restenosis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; angina pectoris; ulcers; benign prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourette's syndrome, among others. Yet another aspect of the invention relates to a method of inducing immunological response in a mammal which comprises, delivering HFIZG53 polypeptide via a vector directing expression of HFIZG53 polynucleotide *in vivo* in order to induce such an immunological response to produce antibody to protect said animal from diseases.

Further aspect of the invention relates to an immunological/vaccine formulation (composition) which, when introduced into a mammalian host, induces an immunological response in that mammal to a HFIZG53 polypeptide wherein the composition comprises a HFIZG53 polypeptide or HFIZGS3 gene. The vaccine formulation may further comprise a suitable carrier. Since HFIZG53 polypeptide may be broken down in the stomach, it is preferably administered parenterally (including subcutaneous, intramuscular, intravenous, intradermal etc. injection). Formulations suitable for parenteral administration include aqueous and non-aqueous sterile injection solutions which may contain anti-oxidants, buffers, bacteriostats and solutes which render the formulation isotonic with the blood of the recipient; and aqueous and non-aqueous sterile suspensions which may include suspending agents or thickening agents. The formulations may be presented in unit-dose or multi-dose containers, for example, sealed ampoules and vials and may be stored in a freeze-dried condition requiring only the addition of the sterile liquid carrier immediately prior to use. The vaccine formulation may also include adjuvant systems for enhancing the immunogenicity of the formulation, such as oil-in-water systems and other systems known in the art. The dosage will depend on the specific activity of the vaccine and can be readily determined by routine experimentation.

Screening Assays

The HFIZG53 polypeptide of the present invention may be employed in a screening process for compounds which activate (agonists) or inhibit activation of (antagonists, or otherwise called inhibitors) the HFIZG53 polypeptide of the present invention. Thus, polypeptides of the invention may also be used to assess identify agonist or antagonists from, for example, cells, cell-free preparations, chemical libraries, and natural product mixtures. These agonists or antagonists may be natural or modified substrates, ligands, enzymes, receptors, etc., as the case may be, of the polypeptide of the present invention; or may be structural or functional mimetics of the polypeptide of the present invention. See Coligan *et al.*, *Current Protocols in Immunology* 1(2):Chapter 5 (1991).

HFIZG53 polypeptides are responsible for many biological functions, including many pathologies. Accordingly, it is desirous to find compounds and drugs which stimulate HFIZG53 polypeptide on the one hand and which can inhibit the function of HFIZG53 polypeptide on the other hand. In general, agonists are employed for therapeutic and prophylactic purposes for such conditions as bone loss including osteoporosis; inflammatory diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other immunodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including resten-

osis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; angina pectoris; ulcers; benign prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourette's syndrome. Antagonists may be employed for a variety of therapeutic and prophylactic purposes for such conditions as bone loss including osteoporosis; inflammatory diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other immunodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including restenosis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; angina pectoris; ulcers; benign prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourette's syndrome.

In general, such screening procedures may involve using appropriate cells which express the HFIZG53 polypeptide or respond to HFIZG53 polypeptide of the present invention. Such cells include cells from mammals, yeast, *Drosophila* or *E. coli*. Cells which express the HFIZG53 polypeptide (or cell membrane containing the expressed polypeptide) or respond to HFIZG53 polypeptide are then contacted with a test compound to observe binding, or stimulation or inhibition of a functional response. The ability of the cells which were contacted with the candidate compounds is compared with the same cells which were not contacted for HFIZG53 activity.

The assays may simply test binding of a candidate compound wherein adherence to the cells bearing the HFIZG53 polypeptide is detected by means of a label directly or indirectly associated with the candidate compound or in an assay involving competition with a labeled competitor. Further, these assays may test whether the candidate compound results in a signal generated by activation of the HFIZG53 polypeptide, using detection systems appropriate to the cells bearing the HFIZG53 polypeptide. Inhibitors of activation are generally assayed in the presence of a known agonist and the effect on activation by the agonist by the presence of the candidate compound is observed.

Further, the assays may simply comprise the steps of mixing a candidate compound with a solution containing a HFIZG53 polypeptide to form a mixture, measuring HFIZG53 activity in the mixture, and comparing the HFIZG53 activity of the mixture to a standard.

The HFIZG53 cDNA, protein and antibodies to the protein may also be used to configure assays for detecting the effect of added compounds on the production of HFIZG53 mRNA and protein in cells. For example, an ELISA may be constructed for measuring secreted or cell associated levels of HFIZG53 protein using monoclonal and polyclonal antibodies by standard methods known in the art, and this can be used to discover agents which may inhibit or enhance the production of HFIZG53 (also called antagonist or agonist, respectively) from suitably manipulated cells or tissues.

The HFIZG53 protein may be used to identify membrane bound or soluble receptors, if any, through standard receptor binding techniques known in the art. These include, but are not limited to, ligand binding and crosslinking assays in which the HFIZG53 is labeled with a radioactive isotope (eg 125I), chemically modified (eg biotinylated), or fused to a peptide sequence suitable for detection or purification, and incubated with a source of the putative receptor (cells, cell membranes, cell supernatants, tissue extracts, bodily fluids). Other methods include biophysical techniques such as surface plasmon resonance and spectroscopy. In addition to being used for purification and cloning of the receptor, these binding assays can be used to identify agonists and antagonists of HFIZG53 which compete with the binding of HFIZG53 to its receptors, if any. Standard methods for conducting screening assays are well understood in the art.

Examples of potential HFIZG53 polypeptide antagonists include antibodies or, in some cases, oligonucleotides or proteins which are closely related to the ligands, substrates, enzymes, receptors, etc., as the case may be, of the HFIZG53 polypeptide, e.g., a fragment of the ligands, substrates, enzymes, receptors, etc.; or small molecules which bind to the polypeptide of the present invention but do not elicit a response, so that the activity of the polypeptide is prevented.

Thus in another aspect, the present invention relates to a screening kit for identifying agonists, antagonists, ligands, receptors, substrates, enzymes, etc. for HFIZG53 polypeptides; or compounds which decrease or enhance the production of HFIZG53 polypeptides, which comprises:

- (a) a HFIZG53 polypeptide, preferably that of SEQ ID NO:2;
- (b) a recombinant cell expressing a HFIZG53 polypeptide, preferably that of SEQ ID NO:2;
- (c) a cell membrane expressing a HFIZG53 polypeptide; preferably that of SEQ ID NO: 2; or
- (d) antibody to a HFIZG53 polypeptide, preferably that of SEQ ID NO: 2.

It will be appreciated that in any such kit, (a), (b), (c) or (d) may comprise a substantial component.

Prophylactic and Therapeutic Methods

This invention provides methods of treating abnormal conditions such as, bone loss including osteoporosis; inflammatory diseases such as Adult Respiratory Disease Syndrome (ARDS), Rheumatoid arthritis, Osteoarthritis, Inflammatory Bowel Disease (IBD), psoriasis, dermatitis, asthma, allergies; infections such as bacterial, fungal, protozoan and viral infections, particularly infections caused by HIV-1 or HIV-2; HIV-associated cachexia and other immunodeficiency disorders; septic shock; pain; injury; cancers including testicular cancer; anorexia; bulimia; Parkinson's disease; cardiovascular disease including restenosis, atherosclerosis, acute heart failure, myocardial infarction; hypotension; hypertension; urinary retention; angina pectoris; ulcers; benign prostatic hypertrophy; and psychotic and neurological disorders, including anxiety, schizophrenia, manic depression, delirium, dementia, severe mental retardation and dyskinesias, such as Huntington's disease or Gilles de la Tourette's syndrome, related to both an excess of and insufficient amounts of HFIZG53 polypeptide activity.

If the activity of HFIZG53 polypeptide is in excess, several approaches are available. One approach comprises administering to a subject an inhibitor compound (antagonist) as hereinabove described along with a pharmaceutically acceptable carrier in an amount effective to inhibit the function of the HFIZG53 polypeptide, such as, for example, by blocking the binding of ligands, substrates, enzymes, receptors, etc., or by inhibiting a second signal, and thereby alleviating the abnormal condition. In another approach, soluble forms of HFIZG53 polypeptides still capable of binding the ligand, substrate, enzymes, receptors, etc. in competition with endogenous HFIZG53 polypeptide may be administered. Typical embodiments of such competitors comprise fragments of the HFIZG53 polypeptide.

In another approach, soluble forms of HFIZG53 polypeptides still capable of binding the ligand in competition with endogenous HFIZG53 polypeptide may be administered. Typical embodiments of such competitors comprise fragments of the HFIZG53 polypeptide.

In still another approach, expression of the gene encoding endogenous HFIZG53 polypeptide can be inhibited using expression blocking techniques. Known such techniques involve the use of antisense sequences, either internally generated or separately administered. See, for example, O'Connor, *JNeurochem* (1991) 56:560 in Oligodeoxynucleotides as Antisense Inhibitors of Gene Expression, CRC Press, Boca Raton, FL (1988). Alternatively, oligonucleotides which form triple helices with the gene can be supplied. See, for example, Lee *et al.*, *Nucleic Acids Res* (1979) 6:3073; Cooney *et al.*, *Science* (1988) 241:456; Dervan *et al.*, *Science* (1991) 251:1360. These oligomers can be administered *per se* or the relevant oligomers can be expressed *in vivo*.

For treating abnormal conditions related to an under-expression of HFIZG53 and its activity, several approaches are also available. One approach comprises administering to a subject a therapeutically effective amount of a compound which activates HFIZG53 polypeptide, i.e., an agonist as described above, in combination with a pharmaceutically acceptable carrier, to thereby alleviate the abnormal condition. Alternatively, gene therapy may be employed to effect the endogenous production of HFIZG53 by the relevant cells in the subject. For example, a polynucleotide of the invention may be engineered for expression in a replication defective retroviral vector, as discussed above. The retroviral expression construct may then be isolated and introduced into a packaging cell transduced with a retroviral plasmid vector containing RNA encoding a polypeptide of the present invention such that the packaging cell now produces infectious viral particles containing the gene of interest. These producer cells may be administered to a subject for engineering cells *in vivo* and expression of the polypeptide *in vivo*. For overview of gene therapy, see Chapter 20, *Gene Therapy and other Molecular Genetic-based Therapeutic Approaches*, (and references cited therein) in Human Molecular Genetics, T Strachan and A P Read, BIOS Scientific Publishers Ltd (1996). Another approach is to administer a therapeutic amount of HFIZG53 polypeptides in combination with a suitable pharmaceutical carrier.

Formulation and Administration

Peptides, such as the soluble form of HFIZG53 polypeptides, and agonists and antagonist peptides or small molecules, may be formulated in combination with a suitable pharmaceutical carrier. Such formulations comprise a therapeutically effective amount of the polypeptide or compound, and a pharmaceutically acceptable carrier or excipient. Such carriers include but are not limited to, saline, buffered saline, dextrose, water, glycerol, ethanol, and combinations thereof. Formulation should suit the mode of administration, and is well within the skill of the art. The invention further relates to pharmaceutical packs and kits comprising one or more containers filled with one or more of the ingredients of the aforementioned compositions of the invention.

Polypeptides and other compounds of the present invention may be employed alone or in conjunction with other compounds, such as therapeutic compounds.

Preferred forms of systemic administration of the pharmaceutical compositions include injection, typically by intravenous injection. Other injection routes, such as subcutaneous, intramuscular, or intraperitoneal, can be used. Alternative means for systemic administration include transmucosal and transdermal administration using penetrants such as bile salts or fusidic acids or other detergents. In addition, if properly formulated in enteric or encapsulated formula-

tions, oral administration may also be possible. Administration of these compounds may also be topical and/or localized, in the form of salves, pastes, gels and the like.

5 The dosage range required depends on the choice of peptide, the route of administration, the nature of the formulation, the nature of the subject's condition, and the judgment of the attending practitioner. Suitable dosages, however, are in the range of 0.1-100 µg/kg of subject. Wide variations in the needed dosage, however, are to be expected in view of the variety of compounds available and the differing efficiencies of various routes of administration. For example, oral administration would be expected to require higher dosages than administration by intravenous injection. Variations in these dosage levels can be adjusted using standard empirical routines for optimization, as is well understood in the art.

10 Polypeptides used in treatment can also be generated endogenously in the subject, in treatment modalities often referred to as "gene therapy" as described above. Thus, for example, cells from a subject may be engineered with a polynucleotide, such as a DNA or RNA, to encode a polypeptide *ex vivo*, and for example, by the use of a retroviral plasmid vector. The cells are then introduced into the subject.

15 All publications, including but not limited to patents and patent applications, cited in this specification are herein incorporated by reference as if each individual publication were specifically and individually indicated to be incorporated by reference herein as though fully set forth.

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Annex to the description

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SEQUENCE LISTING

(1) GENERAL INFORMATION

10

(i) APPLICANT: SmithKline Beecham Corporation

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(ii) TITLE OF THE INVENTION: HFIZG53

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(iii) NUMBER OF SEQUENCES: 4

25

(iv) CORRESPONDENCE ADDRESS:
(A) ADDRESSEE: F J Cleveland & Company
(B) STREET: 40/43 Chancery Lane
(C) CITY: London
(D) COUNTY:
(E) COUNTRY: United Kingdom
(F) POST CODE: WC2A 1JQ

30

(v) COMPUTER READABLE FORM:
(A) MEDIUM TYPE: Diskette
(B) COMPUTER: IBM Compatible
(C) OPERATING SYSTEM: DOS
(D) SOFTWARE: FastSEQ for Windows Version 2.0

35

(vi) CURRENT APPLICATION DATA:
(A) APPLICATION NUMBER: TO BE ASSIGNE
(B) FILING DATE: 17-OCT-1997
(C) CLASSIFICATION: UNKNOWN

40

(vii) PRIOR APPLICATION DATA:
(A) APPLICATION NUMBER: 60/051,937
(B) FILING DATE: 08-JUL-1997

45

(viii) ATTORNEY/AGENT INFORMATION:
(A) NAME: CRUMP, Julian Richard John
(B) GENERAL AUTHORISATION NUMBER: 37127
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50

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 (C) TELEX:

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(2) INFORMATION FOR SEQ ID NO:1:

10 (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1190 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single
- 15 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

20 (xi) SEQUENCE DESCRIPTION: SEQ ID NO:1:

TGCAAATATT TTGCTGTTAA GGATTTAAAA ATAAACAGAA ACATAGAGTA TAAAATTTTC	60
ATTTCACTGT GCCCTCATTT AAAATTATAA GAATATAAGC AAATAACATC CAATGTCAGA	120
AGAGATTCAAG GGTGACCATT TGCAGTATTG AGTGGCAAAT TAGTAGCATC ATGAAAAATT	180
25 TCAATTCAATT TAAAAAAAATA GCTTTCATTT AAATAATAAT TACGTTTAGC TTTATCTCTG	240
TATATAATTAA GACTTTCTTT TGGCTTAGAC AATTCCATT TCTCCAACTG GGAGCTGTGA	300
AGGATCAAGT CCTACTTTCT TCATTGATAC GGCAATATCA AATAAATAGT CATAACACTC	360
30 ACACATGGTT TTGGCCTTCT CCCATGTTTC CCCCCACACA TATACTCCAT GACGTCTGAC	420
CAGTACTGCA CAGGAGTCTG GGTATTCAATT CATTGCATGA GCCATTCTAT CTTTGAGGTC	480
TTTCTCCTCA GGTGTATTCT CAATAATGGG TACCACTAAC ATATCATCAT ATCTATAATA	540
CCCTCCGGAA GTACATTCT TTATTCCTTT TATCATCTCT TGATGTGTAA TTTTAAACTC	600
35 CCGTCCTGGA AAGAGAAGGG TGGCCATCAC AGCAGCTTTA GAGTGGGTAT GAATCACTGC	660
ACCTGCTCCT CTCATTGTGT AAGCATTCAAT GAAAAGAGGA GTACACTGGC TTTTTTTAG	720
CTTCTTCGAT GGCGAAGGTC CACTTATGTC CTTTTCAATT ATATCATAAA CAAACATGTC	780
40 TTCAGGCTGA ATTCTGTTCT TTTGCACTCC TGAAGGAGCA ATGTAGATT CATGCCATG	840
CTTCAAGCTA ATTCCCTCCTC CAGTCCCAGT GACCCAGCCT AAATGGTAA ACTGTTGCA	900
AAGTTCTGGG ATCAGGTATC TTGGATGTC CTTGTCCTGC GCGCCGCATC TCCGGGAACA	960
ACAGTCTCCC TCCCAAGCAT CACAGCCAGA CATGGCCAG ACCAGGGACC CGCGCGGCCT	1020
45 CCAATCTCCG CACGGCTTG CGCGCAGCGC TTAGCCTGGG ATGCGGCAGC GAGGCCGCAA	1080
ATGCAATCAG GCAGCGCTGA GGGCAGCCCG GGGGCGGGGC GAACGGGGCG CGGACGCGTG	1140
GGTCGACCCG GGAATTCCGG ACCGGTACCT GCAGGGCGTAC CAGCTTCCC	1190

(2) INFORMATION FOR SEQ ID NO:2:

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(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 242 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- 55 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

5 (xi) SEQUENCE DESCRIPTION: SEQ ID NO:2:

	Met Ser Gly Cys Asp Ala Trp Glu Gly Asp Cys Cys Ser Arg Arg Cys			
10	1	5	10	15
	Gly Ala Gln Asp Lys Glu His Pro Arg Tyr Leu Ile Pro Glu Leu Cys			
	20	25	30	
	Lys Gln Phe Tyr His Leu Gly Trp Val Thr Gly Thr Gly Gly Ile			
15	35	40	45	
	Ser Leu Lys His Gly Asp Glu Ile Tyr Ile Ala Pro Ser Gly Val Gln			
	50	55	60	
	Lys Glu Arg Ile Gln Pro Glu Asp Met Phe Val Tyr Asp Ile Asn Glu			
20	65	70	75	80
	Lys Asp Ile Ser Gly Pro Ser Pro Ser Lys Lys Leu Lys Ser Gln			
	85	90	95	
	Cys Thr Pro Leu Phe Met Asn Ala Tyr Thr Met Arg Gly Ala Gly Ala			
25	100	105	110	
	Val Ile His Thr His Ser Lys Ala Ala Val Met Ala Thr Leu Leu Phe			
	115	120	125	
	Pro Gly Arg Glu Phe Lys Ile Thr His Gln Glu Met Ile Lys Gly Ile			
30	130	135	140	
	Lys Lys Cys Thr Ser Gly Gly Tyr Tyr Arg Tyr Asp Asp Met Leu Val			
	145	150	155	160
	Val Pro Ile Ile Glu Asn Thr Pro Glu Glu Lys Asp Leu Lys Asp Arg			
35	165	170	175	
	Met Ala His Ala Met Asn Glu Tyr Pro Asp Ser Cys Ala Val Leu Val			
	180	185	190	
	Arg Arg His Gly Val Tyr Val Trp Gly Glu Thr Trp Glu Lys Ala Lys			
40	195	200	205	
	Thr Met Cys Glu Cys Tyr Asp Tyr Leu Phe Asp Ile Ala Val Ser Met			
	210	215	220	
	Lys Lys Val Gly Leu Asp Pro Ser Gln Leu Pro Val Gly Glu Asn Gly			
45	225	230	235	240
	Ile Val			

50 (2) INFORMATION FOR SEQ ID NO:3:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 834 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: single

(D) TOPOLOGY: linear
(ii) MOLECULE TYPE: cDNA

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(xi) SEQUENCE DESCRIPTION: SEQ ID NO:3:

10	CCCCCGTTCG	CCCCGCCCCC	GGGCTGCCCT	CAGCGCTGCC	TGATTGCATT	TGCGGACCC	60
	CGCGTGCCGA	CCCAGGCTAA	GCGCCGCGCA	AAAGCCGTGC	GGAGATTGGA	GGCCGGCGG	120
	GTCCCCTGGTC	TGGGCCATGT	CTGGCTGTGA	TGCTCGGGAG	GGAGACTGTT	GTTCCCGGAG	180
	ATGCGGCGCG	CAGGACAAGG	AGCATCCAAG	ATACCTGATC	CCAGAACTTT	GCAAACAGTT	240
15	TTACCATTAA	GGCTGGGTCA	CTGGGACTGG	AGGAGGAATT	AGCTTGAAGC	ATGGCGATGA	300
	AATCTACATT	GCTCCCTTCAG	GATGCAAAAG	GAACGAATT	AGCCTGAAGA	CATGTTGTT	360
	TGTGATATAA	ATGAAAAGGA	CATAAGTGGG	ACCTTCGCCA	TCGAAGAAGC	TAAAAAAAAG	420
	CCAGTGTACT	CCTCTTTCA	TGAATGCTTA	CACAATGAGA	GGAGCAGGTG	CAGTGATTCA	480
20	TACCCACTCT	AAAGCTGCTG	TGATGGCCAC	ACTTCTCTTT	CCAGGACGGG	AGTTAAAAAT	540
	TACACATCAA	GAGATGATAA	AAGGAATAAA	GAAATGTACT	TCCGGAGGTA	TTATAGATAT	600
	GATGATATGT	TAGTGGTACC	CATTATTGAG	AATACACCCG	GAGGAGAAAG	ACCCCAAAGA	660
	TAGAATGGCC	CGGCCNACCA	ATTGATAACCC	AGACTCCTGT	GCATACTGGT	CAACGGCTGG	720
25	GNGTATATTN	TTTGGGGGGG	AACATGGGAG	AAGGCCAAC	CNGTGTGATT	TTATGNCATT	780
	ATTTGAAATT	GCGTTCCAT	NAGAATNGGG	CTTNCCCTTC	AAATCCCCTT	TGGG	834

(2) INFORMATION FOR SEQ ID NO:4:

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(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 39 amino acids

(B) TYPE: amino acid

(C) STRANDEDNESS: single

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 1:

Claims

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1. An isolated polynucleotide comprising a nucleotide sequence that has at least 80% identity over its entire length to a nucleotide sequence encoding the HF1ZG53 polypeptide of SEQ ID NO:2; or a nucleotide sequence complementary to said isolated polynucleotide.

2. The polynucleotide of claim 1 wherein said polynucleotide comprises the nucleotide sequence contained in SEQ ID NO: 1 encoding the HFIZG53 polypeptide of SEQ ID NO2.
3. The polynucleotide of claim 1 wherein said polynucleotide comprises a nucleotide sequence that is at least 80% identical to that of SEQ ID NO: 1 over its entire length.
4. The polynucleotide of claim 3 which is polynucleotide of SEQ ID NO: 1.
5. The polynucleotide of claim 1 which is DNA or RNA.
6. A DNA or RNA molecule comprising an expression system, wherein said expression system is capable of producing a HFIZG53 polypeptide comprising an amino acid sequence, which has at least 80% identity with the polypeptide of SEQ ID NO:2 when said expression system is present in a compatible host cell.
- 15 7. A host cell comprising the expression system of claim 6.
8. A process for producing a HFIZG53 polypeptide comprising culturing a host of claim 7 under conditions sufficient for the production of said polypeptide and recovering the polypeptide from the culture.
- 20 9. A process for producing a cell which produces a HFIZG53 polypeptide thereof comprising transforming or transfecting a host cell with the expression system of claim 6 such that the host cell, under appropriate culture conditions, produces a HFIZG53 polypeptide.
- 25 10. A HFIZG53 polypeptide comprising an amino acid sequence which is at least 80% identical to the amino acid sequence of SEQ ID NO:2 over its entire length.
11. The polypeptide of claim 10 which comprises the amino acid sequence of SEQ ID NO:2.
- 30 12. An antibody immunospecific for the HFIZG53 polypeptide of claim 10.
13. A method for the treatment of a subject in need of enhanced activity or expression of HFIZG53 polypeptide of claim 10 comprising:
 - 35 (a) administering to the subject a therapeutically effective amount of an agonist to said polypeptide; and/or (b) providing to the subject an isolated polynucleotide comprising a nucleotide sequence that has at least 80% identity to a nucleotide sequence encoding the HFIZG53 polypeptide of SEQ ID NO:2 over its entire length; or a nucleotide sequence complementary to said nucleotide sequence in a form so as to effect production of said polypeptide activity *in vivo*.
- 40 14. A method for the treatment of a subject having need to inhibit activity or expression of HFIZG53 polypeptide of claim 10 comprising:
 - 45 (a) administering to the subject a therapeutically effective amount of an antagonist to said polypeptide; and/or (b) administering to the subject a nucleic acid molecule that inhibits the expression of the nucleotide sequence encoding said polypeptide; and/or (c) administering to the subject a therapeutically effective amount of a polypeptide that competes with said polypeptide for its ligand, substrate, or receptor.
- 50 15. A process for diagnosing a disease or a susceptibility to a disease in a subject related to expression or activity of HFIZG53 polypeptide of claim 10 in a subject comprising:
 - 55 (a) determining the presence or absence of a mutation in the nucleotide sequence encoding said HFIZG53 polypeptide in the genome of said subject; and/or (b) analyzing for the presence or amount of the HFIZG53 polypeptide expression in a sample derived from said subject.
16. A method for identifying compounds which inhibit (antagonize) or agonize the HFIZG53 polypeptide of claim 10 which comprises:

(a) contacting a candidate compound with cells which express the HFIZG53 polypeptide (or cell membrane expressing HFIZG53 polypeptide) or respond to HFIZG53 polypeptide; and
5 (b) observing the binding, or stimulation or inhibition of a functional response; or comparing the ability of the cells (or cell membrane) which were contacted with the candidate compounds with the same cells which were not contacted for HFIZG53 polypeptide activity.

17. An agonist identified by the method of claim 16.

18. An antagonist identified by the method of claim 16.

10 19. A recombinant host cell produced by a method of Claim 9 or a membrane thereof expressing a HFIZG53 polypeptide.

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